

## LETTER TO THE EDITOR

# Construction of Health Evaluation Model for Ecological Landscape Environment in Nature Reserves

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In order to further improve the health of the ecological landscape environment in the nature reserve, this paper takes the Xinqing White-headed Crane Nature Reserve in Heilongjiang Province as an example to obtain the health level of tourism ecological in the nature reserve, and constructs the comprehensive linear weighting function model of the evaluation index. It is suggested to construct the target management mechanism for tourism ecological health, implement the auditing system for tourism environment, and improve the monitoring and early warning system for tourism ecology. The compensation mechanism of tourism ecology is constructed to encourage tourism communities to participate in tourism ecological environment protection and to effectively manage the tourism ecological health of the case.

Nature reserve; ecological landscape environment; health; evaluation model

### 1 Introduction

At present, China has established 363 national nature reserves with a total area of 94.15 million  $\text{hm}^2$ , accounting for 9.7% of the country's land area. Due to the richness of tourism resources, the diversity of biological species, the monopoly of natural landscapes, and the coordination of human-land relationships, many nature reserves have become hotspots for eco-tourism. This makes the contradiction between the development of tourism and the protection of the ecological environment in the nature reserve increasingly prominent. Therefore, how to coordinate the relationship between the two and promote the sustainable development of tourism within the nature reserve has become a matter of great concern to the academic community (Hsueh and Su 2017, Mousakhani et al. 2017, Shen et al. 2017). As a new concept of sustainable development and ecosystem management, the concept of ecological health has been officially introduced since 1989. It has received extensive attention and has become one of the hot issues in the study of ecology, resource science, geography and other disciplines. The study of ecological health by scholars at home and abroad begins with the discussion of its concept and connotation. With the deepening of the understanding of ecological health, its research content has gradually expanded to the evaluation of ecological health, technology of ecological health, interference factors of ecological health and process of space-time evolution. The relationship between ecological health and carrying capacity, human settlements and human health, the impact of economic activities on ecological health, the management of ecological health and the theory of ecological health abroad have gradually become research hotspots. Among them, the research literature on ecological health evaluation is the most common.

Huang and Reynoso (2018) published an article in the *Ekoloji* (Issue 106, 2018), entitled "Based on Physical

Self-Concept to Discuss the Effect of Environmental Education on Health Related Physical Education”. The main result of this document is the impact of the ecological environment on human health. The literature results show that environmental education has the significant positive impact on the concept of physical self. This study puts forward some suggestions, hopes to improve the physical fitness related to human health, and provide reference for the protection of natural ecological landscape environment, and provide reference for future research.

Madeira et al. (2018) developed and tested for biological monitoring of current and projected heat stress in such ecosystems to assess the vulnerability of ecological landscapes. Several species representing different fauna (fish, crustaceans and gastropods) were collected from the field to form a small experimental natural ecosystem and tested for 28 days. The sample health indicators were collected weekly, and the ecological vulnerability was analyzed in combination with the overall index estimated by the biological organization level. However, the results have certain limitations. The experimental objects are self-made ecosystems, which are not representative, so the results obtained are not convincing.

In response to this problem, this study takes the Xinqing White-headed Crane Nature Reserve in Heilongjiang Province as an example, and introduces the ecological health theory into the research of the tourism ecosystem in the nature reserve under the guidance of the concept of sustainable development. A set of tourism eco-health evaluation indicators system was constructed to evaluate the tourism ecological health status, in order to coordinate the relationship between tourism development and ecological environment protection in the nature reserve, and explore the management and maintenance path of the tourism ecological environment (Le et al. 2017).

## **2 Idea description**

### **2.1 Summary of White-headed Crane Nature Reserve in Heilongjiang Province**

Heilongjiang White-headed Crane Nature Reserve is located in Xinqing District, Yichun City, on the northern slope of the eastern side of Xiaoxing'an Mountains. Its geographic coordinates are 48 degrees 19'21 48 degrees 40'20N, 129 degrees 58'29 130 degrees 23'07E and its total area is 62 567 hm<sup>2</sup>. It is the forest ecosystem composed of different plant communities, such as forests, shrubs, meadows, marshes and wetlands. It was approved as the national level by the State Council in 2009. The nature reserve mainly protects the white-headed crane (country first-level protected animal) and its living environment (Evans-Agnew et al. 2018). The Xinqing National Nature Reserve is the low-lying hilly landform with high and central lowlands on the northwest and southeast, and belongs to the temperate continental monsoon climate. The reserve has played an active role in protecting the cranes and their living environment, and also provided the important resource base for the development of ecotourism. However, with the increasing intensity of tourism development in recent years, the shrinkage of wildlife habitats, the reduction of biodiversity, and the decline of ecological functions threaten the tourism ecological security of the White-headed Crane Nature Reserve in Heilongjiang Province.

### **2.2 Construction of health evaluation model for ecological landscape environment in nature reserves**

Tourism ecological health means that the ecosystem of the tourist destination is stable, dynamic and sustainable. It is able to maintain an organizational structure, produce tourism products and services, and meet the needs of sustainable development of tourism destinations. After being disturbed by human tourism activities, it can automatically recover over a period of time. The PSR model can clearly reflect the changes in ecosystem health caused by human activities and natural factors, as well as the regulation and restoration mechanism of the tourism ecosystem and the response of humans to ecosystem changes. It can not only relatively objectively express the relationship between “stress”, “state” and “response”, but also scientifically describe the internal mechanism and process of the ecosystem (Buse et al. 2018). In tourism destinations, the “stress” of ecological

health is the pressure on the ecological health of tourism by human tourism activities and the social and economic activities of local communities. “State” is the state of health of the tourism ecosystem under current pressure. “Response” refers to the countermeasures and measures taken to maintain the health of the tourism ecosystem. Following the principles of science, operability, systemicity, quantitative and qualitative combination, combined with the actual situation of the case, the PSC model-based health evaluation index system of tourism ecological in nature reserve was constructed.

Based on the classification of ecosystem health, this paper divides the health index of tourism ecosystem in nature reserve into five grades in order of large to small, that is, very healthy, healthy, sub-healthy, unhealthy, and morbid.

**Table 1 Classification of tourism ecological health in nature reserves**

Evaluation	$\geq 9$	7-9	4-7	2-4	$\leq 2$
level	very healthy	healthy	sub-healthy	unhealthy	morbid

**2.3 Construction of evaluation model**

This study constructed the quantitative evaluation index, and the evaluation score was obtained according to the degree of membership. If the original value of the indicator falls within a certain score interval, its membership degree is 1. Relative to other intervals, the membership degree is 0, and the corresponding score is assigned. The acquisition of qualitative indicator scores is mainly obtained by consulting experts and industry managers familiar with XinqingWhite-headed Crane Nature ReserveWetland Park. In this paper, the linear weighted function model and the comprehensive evaluation model are used to comprehensively evaluate the tourism ecological health of nature reserves. Its expression is:

$$M = \sum_{h=1}^p \left( \sum_{j=1}^m \alpha_i \omega_j \right) \delta_h \tag{1}$$

Where  $M$  is the comprehensive evaluation score, which is the tourism ecological health index of the nature reserve,  $\alpha_i$  is the score of the evaluation index  $i$ .  $\omega_j$  is the comprehensive weight of the evaluation index  $i$  relative to the  $j$  th subsystem,  $\delta_h$  is the subsystem weight;  $p$  is the child The number of systems,  $m$  is the number of evaluation indicators in the subsystem.

**3 Results**

Based on the analysis of the connotation of tourism ecological health, this paper constructs the tourism ecological health assessment model for the White-headed Crane Nature Reserve in Heilongjiang Province. The evaluation indicators were measured with reference to relevant national standards. Based on the classification of the health level of tourism ecology, the tourism ecological health of XinqingWhite-headed Crane Nature Reserve was evaluated. The results show that the tourism ecological health level of XinqingWhite-headed Crane Nature Reserve in Heilongjiang Province is healthy, and the three subsystems of stress, state and response are in health level (Salinas et al. 2017, Ebadifar et al. 2018).

**4 Discussion**

It is recommended to take the following measures to maintain the tourism ecological health of the case: 1. It is necessary to construct the goal management mechanism for tourism ecological health of the four-in-one

“ecological-economic-social-culture” in order to improve the comprehensive management level of tourism ecological environment, enhance environmentally conscious of residents and tourists and regulate the behavior of developers and operators. 2. It is necessary to implement an auditing system for the tourism ecological environment of protected areas. The administrative management, tourism products and projects, development and construction, and tourism transactions of the Xinqing White-headed Crane Nature Reserve were audited. Reduce the ecological risk of tourism development by improving the ecological environment audit system. 3. On the basis of fully collecting and improving the relevant information of the ecological environment and ecosystem elements in the White-headed Crane Nature Reserve, the “3S” technology and ecological related technologies are used to construct the digital monitoring and early warning system for tourism ecological environment. 4. The government management department can construct and improve the compensation mechanism of the tourism ecology in Xinqing White-headed Crane Nature Reserve by collecting tourism resource usage fees, tourism franchise fees, tourism environmental quality guarantees and collecting compensation fees from external beneficiaries. 5. The mechanism for community participation in tourism decision-making has been improved in order to strengthen the construction of community ecological facilities and encourage community residents to participate in the tourism development of the protected areas and the maintenance of tourism ecological health.

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